Figure 4-8a. Control system schematic for single building hydronic heating system with hot water boiler.
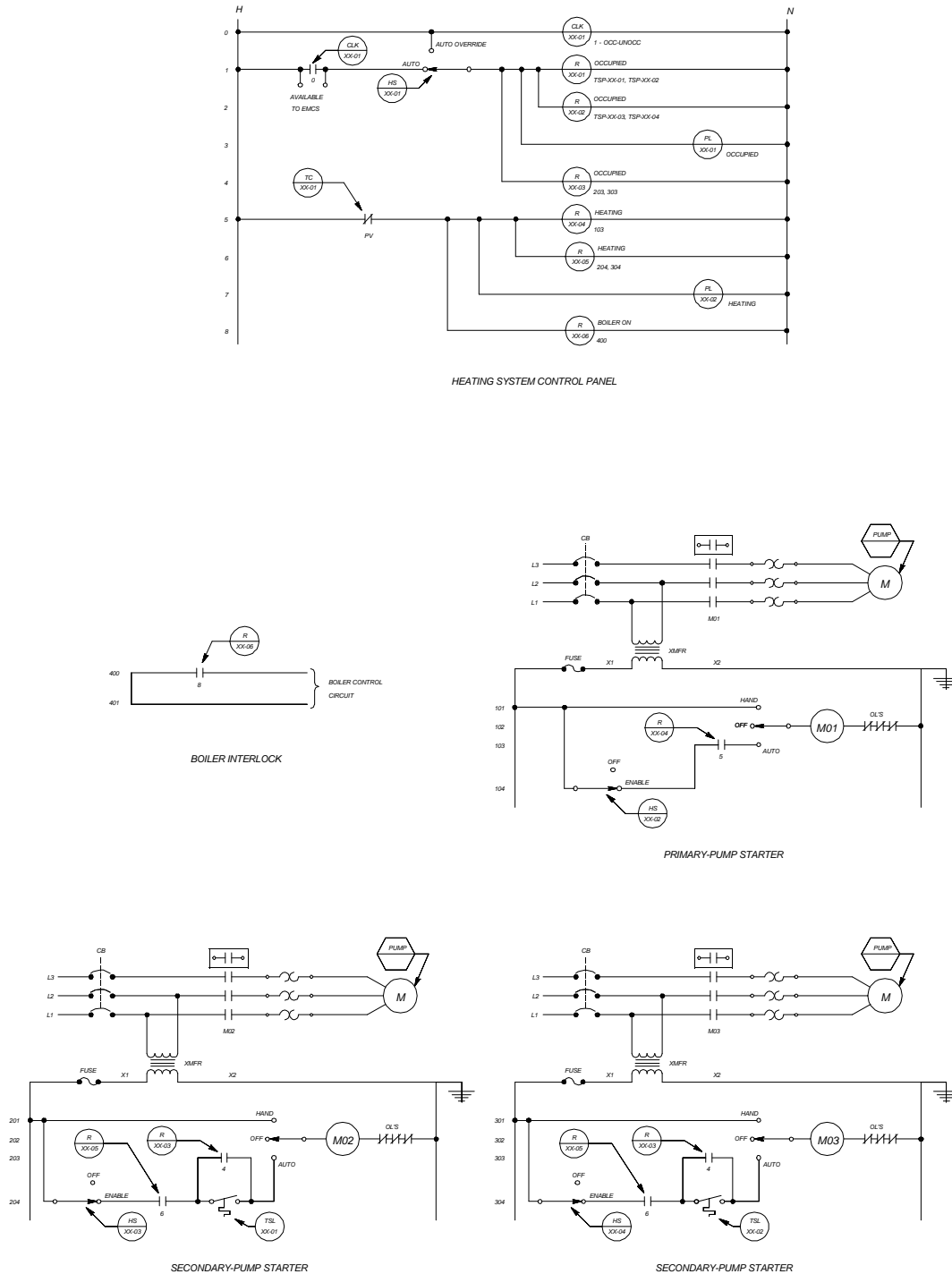
Figure 4-8b. Control system ladder diagram for single building hydronic heating system with hot water boiler.

LOOP CONTROL FUNCTION	DEVICE NUMBER	DEVICE FUNCTION	SETPOINT	RANGE	ADDITIONAL PARAMETERS
HW SUPPLY TEMPERATURE	VLV-XX-01	SYSTEM VALVE	———	21 - 103 kPa (3-15 PSIG)	Kv = 17.3 (Cv = 20) CLOSE AGAINST 70 kPa (10 PSIG)
	TC-XX-01	OUTSIDE-AIR TEMPERATURE CONTROLLER	-1 DEG C (30 DEG F) PROPORTIONAL BAND 37.5% MANUAL RESET 50%	-35 TO +55 DEG C (-30 TO +130 DEG F)	PV CONTACT STARTS PUMP AT 16 DEG C (60 DEG F) STOPS PUMP AT 17 DEG C (62 DEG F)
	TC-XX-02	SYSTEM-SUPPLY TEMPERATURE CONTROLLER	OA TEMP = -18 DEG C (0 DEG F), HWS TEMP = 93 DEG C (200 DEG F) OA TEMP = 16 DEG C (60 DEG F), HWS TEMP = 38 DEG C (100 DEG F)	PV = 38 TO 121 DEG C (100 TO 250 DEG F) CPA = 38 TO 93 DEG C (100 TO 200 DEG F)	CPA LO-LIMIT = 38 DEG C (100 DEG F) CPA HI-LIMIT = 93 DEG C (200 DEG F)
	TT-XX-01	OUTSIDE-AIR TEMPERATURE TRANSMITTER	———	-35 TO +55 DEG C (-30 TO +130 DEG F)	———
	TT-XX-02	SYSTEM-SUPPLY TEMPERATURE TRANSMITTER	———	38 TO 121 DEG C (100 TO 250 DEG F)	———
SPACE TEMPERATURE	TT-XX-03	SPACE-TEMPERATURE TRANSMITTER	———	10 TO 30 DEG C (50 TO 85 DEG F)	———
	VLV-XX-02	ZONE VALVE	———	21 - 103 kPa (3-15 PSIG)	Kv = 6 (Cv = 7) CLOSE AGAINST 70 kPa (10 PSIG)
	TC-XX-03	SPACE TEMPERATURE CONTROLLER	21 DEG C (70 DEG F)	10 TO 30 DEG C (50 TO 85 DEG F)	SET LIMITS AVAILABLE TO OCCUPANT BY TSP-XX-01 AT 19 TO 22 DEG C (66 TO 72 DEG F)
	TSP-XX-01	MANUAL SETPOINT ADJUSTMENT	4 MA = 10 DEG C (50 DEG F) 20 MA = 29 DEG C (85 DEG F)	———	AVAILABLE TO OCCUPANT
	TSP-XX-02	MANUAL SETPOINT ADJUSTMENT	14 DEG C (57 DEG F)	———	———
SPACE LOW-LIMIT TEMPERATURE	TSL-XX-01	SPACE LOW-LIMIT THERMOSTAT	13 DEG C (55 DEG F)	———	STARTS PUMP AT 13 DEG C (55 DEG F) STOPS PUMP AT 14 DEG C (57 DEG F)
SPACE TEMPERATURE	TT-XX-04	SPACE TEMPERATURE TRANSMITTER	———	10 TO 30 DEG C (50 TO 85 DEG F)	———
	VLV-XX-03	ZONE VALVE	———	21 - 103 kPa (3-15 PSIG)	Kv = 6 (Cv = 7) CLOSE AGAINST 70 kPa (10 PSIG)
	TC-XX-04	SPACE TEMPERATURE CONTROLLER	21 DEG C (70 DEG F)	10 TO 30 DEG C (50 TO 85 DEG F)	SET LIMITS AVAILABLE TO OCCUPANT BY TSP-XX-03 AT 19 TO 22 DEG C (66 TO 72 DEG F)
	TSP-XX-03	MANUAL SETPOINT ADJUSTMENT	4 MA = 10 DEG C (50 DEG F) 20 MA = 29 DEG C (85 DEG F)	———	AVAILABLE TO OCCUPANT
	TSP-XX-04	MANUAL SETPOINT ADJUSTMENT	14 DEG C (57 DEG F)	———	———
SPACE LOW-LIMIT TEMPERATURE	TSL-XX-02	SPACE LOW-LIMIT THERMOSTAT	13 DEG C (55 DEG F)	———	STARTS PUMP AT 13 DEG C (55 DEG F) STOPS PUMP AT 14 DEG C (57 DEG F)
OCCUPIED MODE	CLK-XX-01 CONTACT	365-DAY SCHEDULE	———	NORMAL SCHEDULE: M - F CONTACT CLOSED: 0700 HRS CONTACT OPEN: 1700 HRS	CONTACT OPEN: SAT, SUN

NOTE : OTHER CONTROL DEVICES SUCH AS IPS AND RELAYS ARE NOT SHOWN

Figure 4-8c. Control system equipment for single building hydronic heating system with hot water boiler.

FRONT VIEW

REAR VIEW

SWITCH AND PILOT LIGHT LEGEND

POSITION LEGEND	DEVICE TYPE	IDENTIFIER	POSITION LEGEND	DEVICE TYPE	IDENTIFIER
1 - AUTO/AUTO OVERRIDE	ILLUMINATED MAINTAINED CONTACT INTERLOCKED SWITCHES	HS-XX-01	4 - ENABLE/OFF	ILLUMINATED MAINTAINED CONTACT INTERLOCKED SWITCHES	HS-XX-04
2 - ENABLE/OFF	ILLUMINATED MAINTAINED CONTACT INTERLOCKED SWITCHES	HS-XX-02	5 - OCCUPIED	PILOT LIGHT	PL-XX-01
3 - ENABLE/OFF	ILLUMINATED MAINTAINED CONTACT INTERLOCKED SWITCHES	HS-XX-03	6 - HEATING	PILOT LIGHT	PL-XX-02

Figure 4-8d. Control panel interior door layout for single building hydronic heating system with hot water boiler.

REFER TO FIGURE 4-8F FOR TERMINAL LOCATIONS 1 THROUGH 70

REFER TO FIGURE 4-8F FOR TERMINAL LOCATIONS 71 THROUGH 140

REFER TO FIGURE 4-8F FOR TERMINAL LOCATIONS 141 THROUGH 210

TSP-
XX-02

TSP-
XX-04

TIMECLOCK

TO I/P TRANSDUCERS

TO MAIN AIR

BULKHEAD FITTING
FOR AIR LINE (TYP)

Figure 4-8e. Control panel back panel layout for single building hydronic heating system with hot water boiler.

1-10	11-20	21-30	31-40	41-50	51-60	61-70
TC-XX-01	TC-XX-02	TC-XX-03	TC-XX-04	RESERVED FOR	RESERVED FOR	RESERVED FOR
OUTSIDE AIR TEMPERATURE	HOT WATER SUPPLY	SPACE TEMPERATURE	SPACE TEMPERATURE	CONTROLLER	CONTROLLER	CONTROLLER
CONTROLLER	TEMPERATURE CONTROLLER	CONTROLLER	CONTROLLER			
TERMINAL BLOCKS	TERMINAL BLOCKS	TERMINAL BLOCKS	TERMINAL BLOCKS			

71-72	73-80	81-84	85-90	91-100	101-110	111-120	121-130	131-132	133-134	135-140
BOILER CONTROLS	SPACE	CLK-XX-01 EMCS REPLACE-MENT	SPACE	SPACE	SPACE	SPACE	SPACE	TSL-XX-01	TSL-XX-02	SPACE

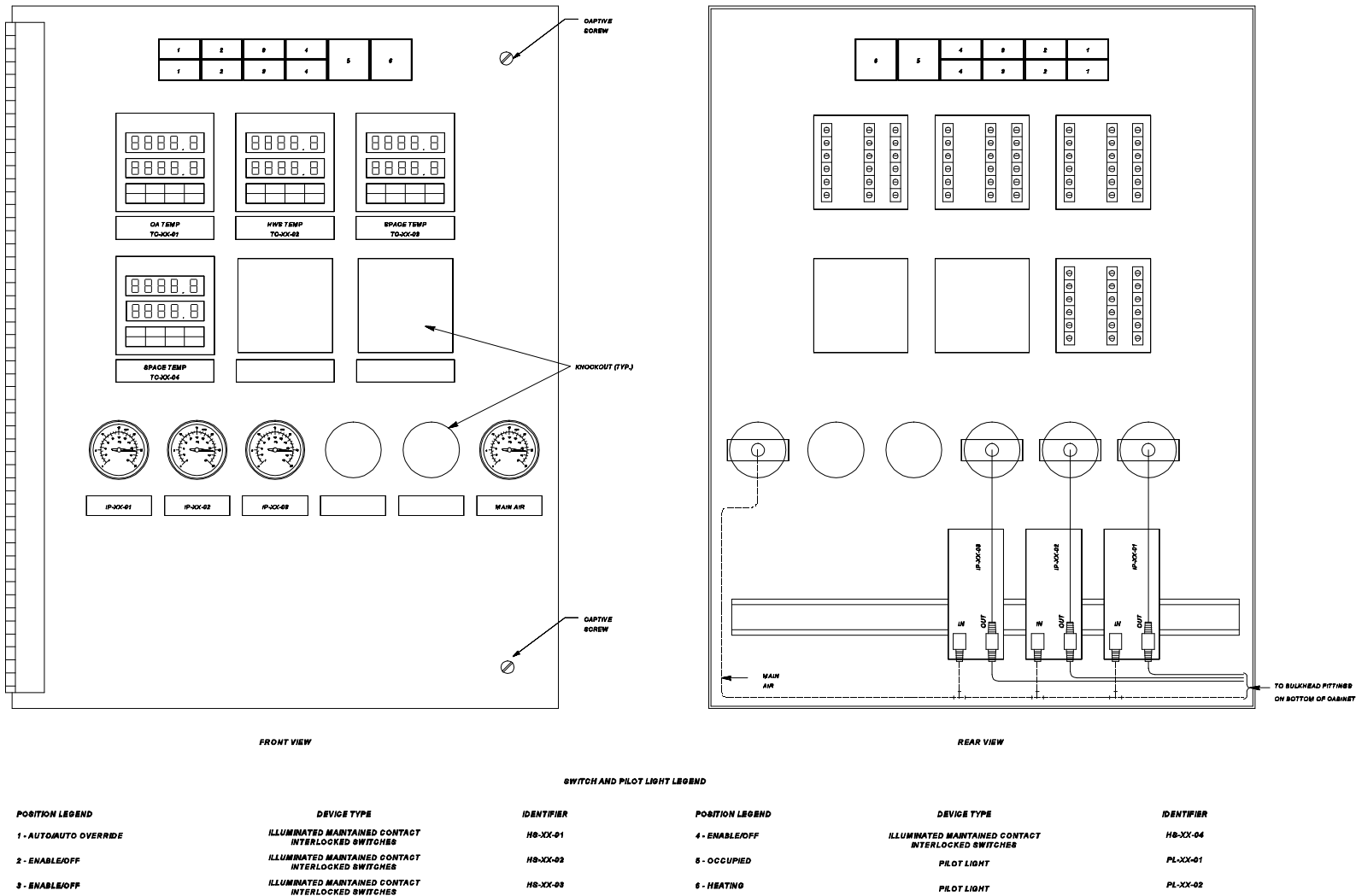| 141-170	171-180	181-190	191-200	201-210
120 V AC POWER DISTRIBUTION TERMINAL BLOCKS	24 V DC POWER	PUMP-XX-01 STARTER	PUMP-XX-02 STARTER	PUMP-XX-03 STARTER
	DISTRIBUTION	CONTROL WIRING	CONTROL WIRING	CONTROL WIRING
	TERMINAL BLOCKS	TERMINAL BLOCKS	TERMINAL BLOCKS	TERMINAL BLOCKS

Figure 4-8f. Control panel terminal block layout for single building hydronic heating system with hot water boiler.

Figure 4-8g. DDC control system schematic for single building hydronic heating system with hot water boiler.

Figure 4-8h. DDC control system ladder diagram for single building hydronic heating system with hot water boiler.
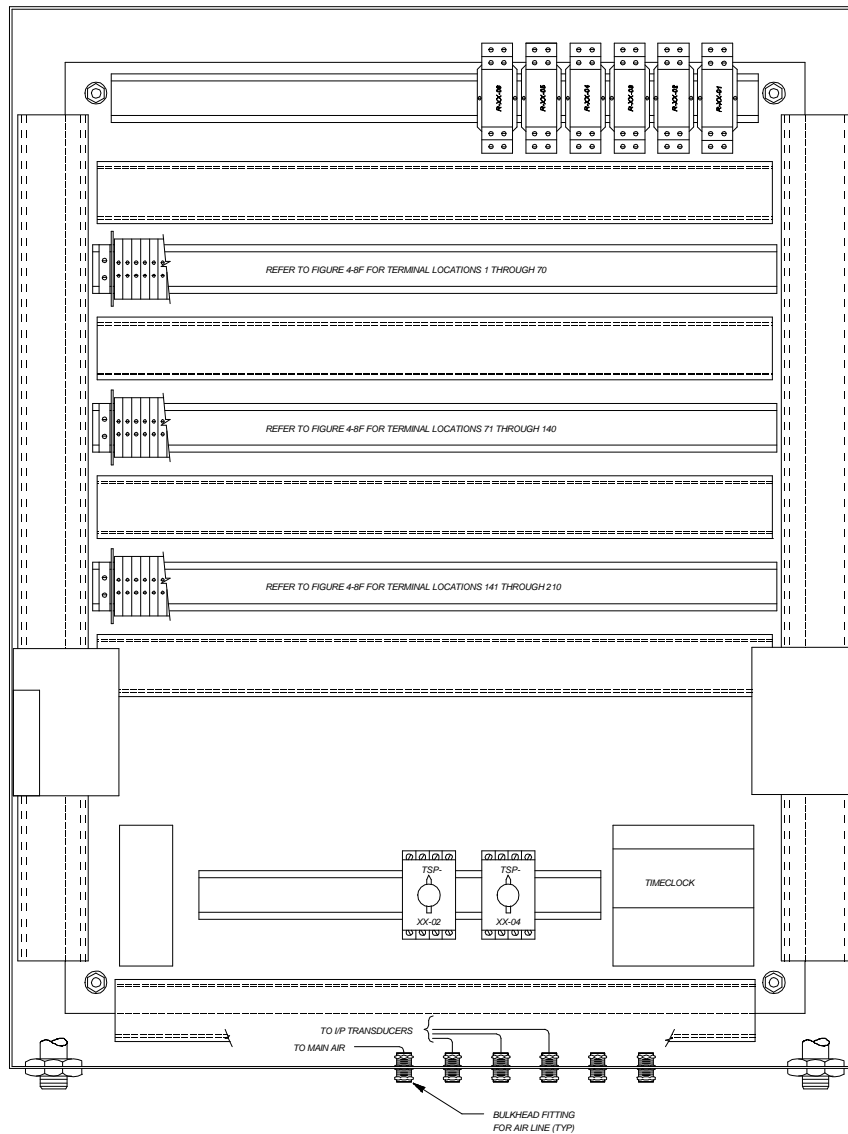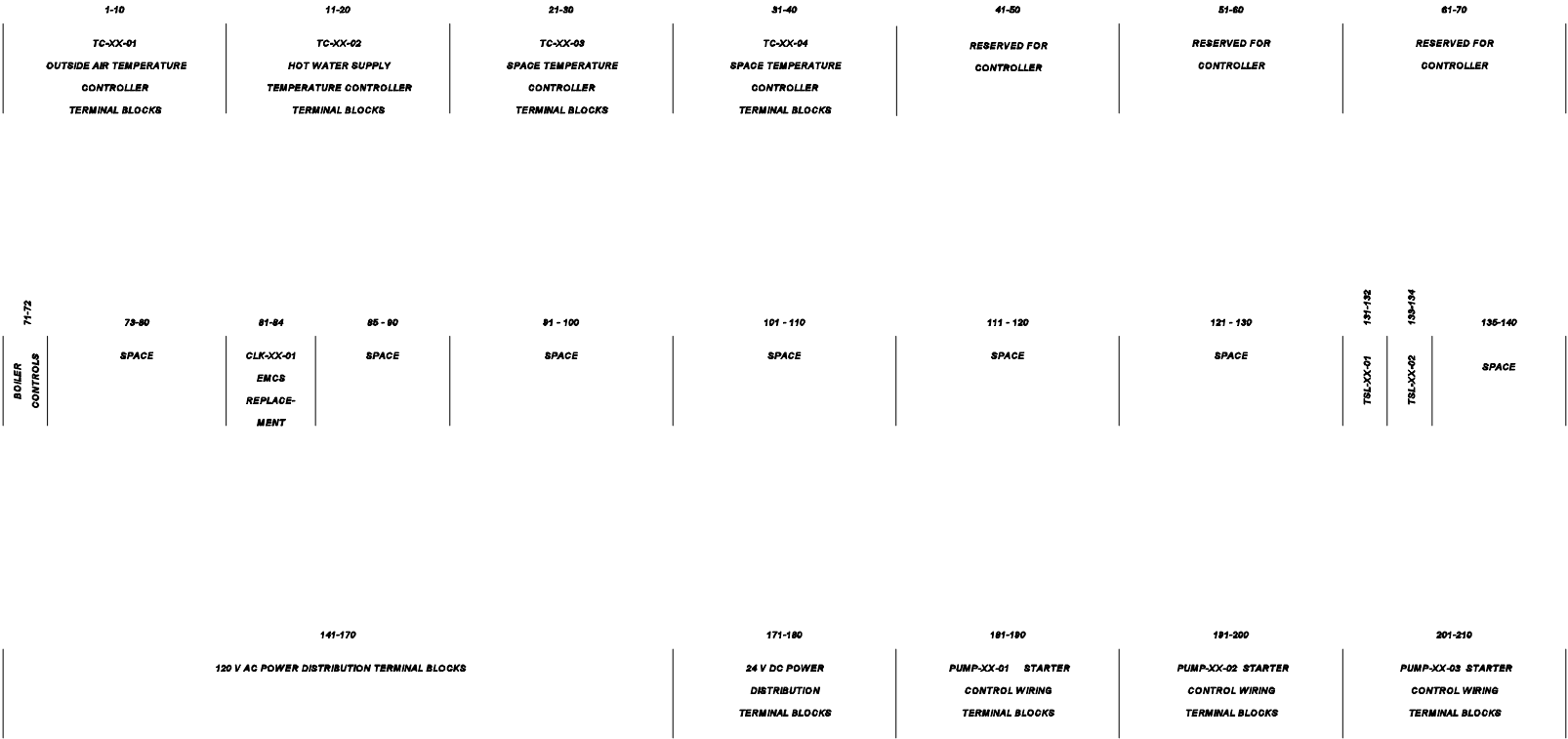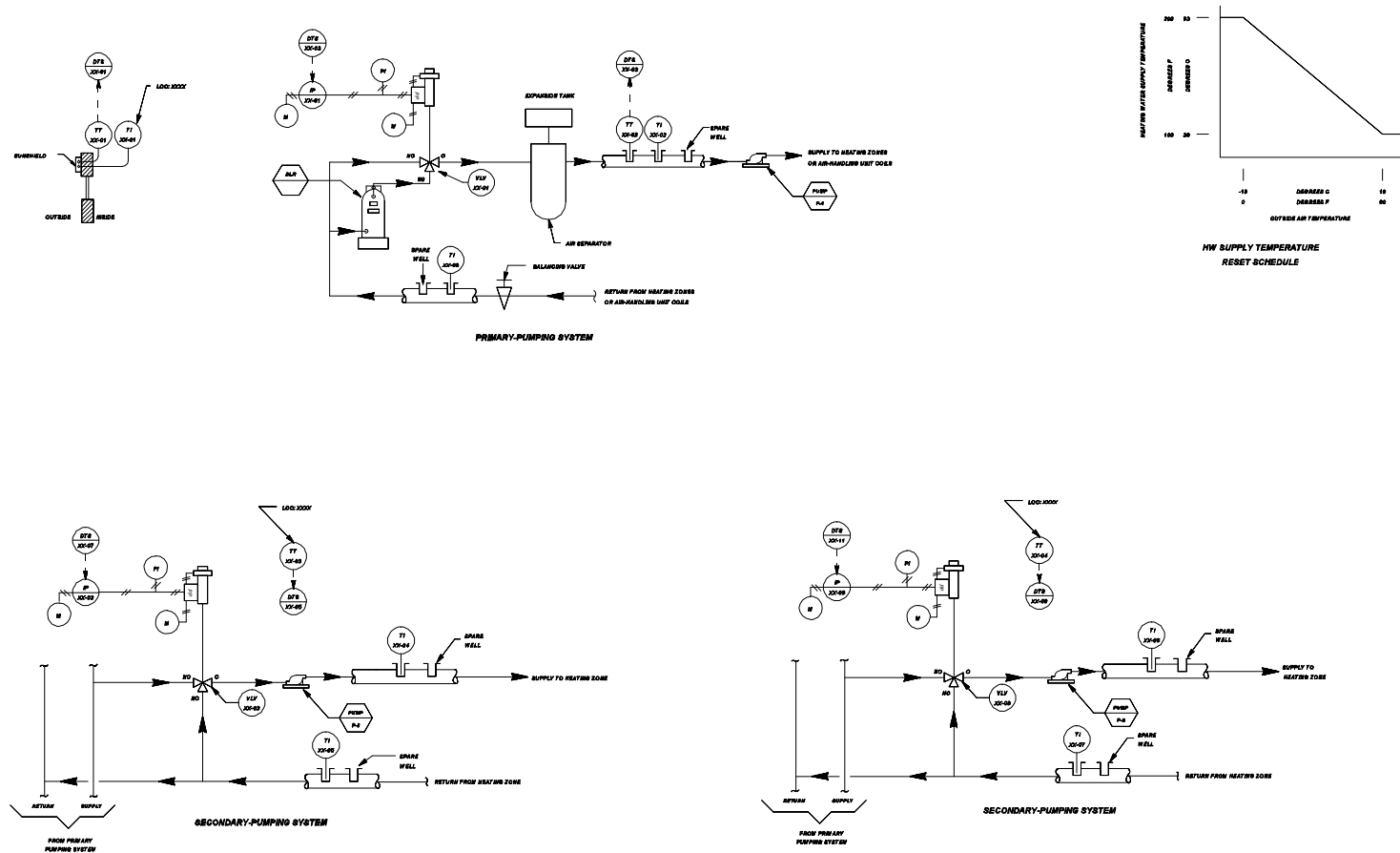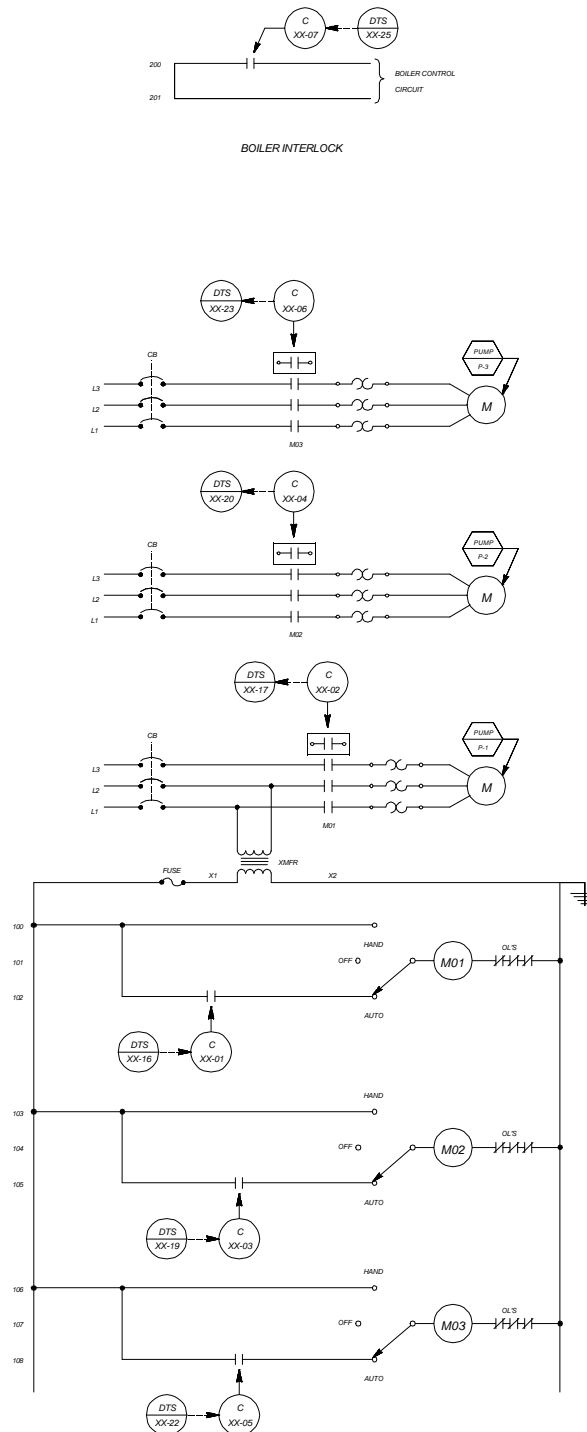
SENSOR SCHEDULE

IDENTIFIER	FUNCTION	RANGE
TT-XX-01	OUTSIDE AIR TEMPERATURE TRANSMITTER	-35 TO +55 DEG C (-30 TO +130 DEG F)
TT-XX-02	PRIMARY SYSTEM SUPPLY TEMPERATURE TRANSMITTER	38 TO 121 DEG C (100 TO 250 DEG F)
TT-XX-03	SPACE TEMPERATURE TRANSMITTER	10 TO 30 DEG C (50 TO 85 DEG F)
TT-XX-04	SPACE TEMPERATURE TRANSMITTER	10 TO 30 DEG C (50 TO 85 DEG F)

CONTROL VALVE SCHEDULE

IDENTIFIER	FUNCTION	TYPE	RANGE	Kv (Cv)	CLOSE-OFF RATING	REMARKS
VLV-XX-01	PRIMARY SYSTEM VALVE	3-WAY, MODULATING	21 - 103 kPa (3-15 PSIG)	XX	XX kPa (XX PSIG)	
VLV-XX-02	ZONE VALVE	3-WAY, MODULATING	21 - 103 kPa (3-15 PSIG)	XX	XX kPa (XX PSIG)	
VLV-XX-03	ZONE VALVE	3-WAY, MODULATING	21 - 103 kPa (3-15 PSIG)	XX	XX kPa (XX PSIG)	

OPERATING PARAMETERS

FUNCTION	SETPOINT	REMARKS
OUTSIDE AIR TEMPERATURE		START PRIMARY PUMP AT OA TEMP = XX DEG C (XX DEG F) STOP PRIMARY PUMP AT OA TEMP = XX DEG C (XX DEG F)
PRIMARY SYSTEM SUPPLY TEMPERATURE	XX DEG C (XX DEG F)	OA TEMP = -18 DEG C (0 DEG F): PRIMARY SYSTEM SUPPLY SETPOINT = 93 DEG C (200 DEG F) OA TEMP = 16 DEG C (60 DEG F): PRIMARY SYSTEM SUPPLY SETPOINT = 38 DEG C (100 DEG F)
SPACE TEMP. (OCCUPIED)	XX DEG C (XX DEG F)	
SPACE TEMP. (UNOCCUPIED)	XX DEG C (XX DEG F)	
OCCUPIED MODE		MONDAY - FRIDAY : 0705 HRS - 1700 HRS

Figure 4-8i. DDC control system equipment for single building hydronic heating system with hot water boiler.

	HARDWARE								SOFTWARE									
	OUTPUT			INPUT					ALARMS				APPLICATION PROGRAMS					
	DIGITAL	ANALOG		DIGITAL	ANALOG				DIGITAL	ANALOG								
	CONTROL RELAY	POSITION ADJUSTMENT	CONTROL POINT ADJUST.	AUXILIARY CONTACT	TEMPERATURE	CONTROL POINT ADJUST.	PRES, PWR, PRSD	FLOW	CONTACT CLOSURE	HIGH LIMIT	LOW LIMIT	RUN TIME	SCHEDULED START/STOP	OPTIMUM START/STO	DUTY CYCLING	DEMAND LIMITING	HW OA RESET	FAILURE MODE **
OUTSIDE AIR					1						x						x	
PRIMARY SYSTEM HW SUPPLY					1					x	x						x	
ZONE					1					x	x							
ZONE					1					x	x							
PRIMARY SYSTEM VALVE		1															x	
ZONE VALVE		1																
ZONE VALVE		1																
PRIMARY PUMP	1			1					x			x	x	x	x	x		
ZONE PUMP	1			1					x			x	x	x	x	x		
ZONE PUMP	1			1					x			x	x	x	x	x		
BOILER INTERLOCK	1								x			x	x	x				

```
**    C - LAST COMMAND        O - ON (OPEN)
      H - HIGH VALUE          F - OFF (CLOSED)
      L - LOW VALUE
```

DDC DATA TERMINAL STRIP LAYOUT

	DEVICE NO.	DESCRIPTION	TYPE
1	TT-XX-01	OUTSIDE AIR TEMPERATURE	AI
2	TT-XX-02	PRIMARY SYSTEM SUPPLY TEMP.	AI
3	IP-XX-01	PRIMARY SYSTEM VALVE	AO
4			
5	TT-XX-03	SPACE TEMPERATURE	AI
6			
7	IP-XX-02	ZONE VALVE	AO
8			
9	TT-XX-04	SPACE TEMPERATURE	AI
10			
11	IP-XX-03	ZONE VALVE	AO
12			
13			
14			
15			
16	C-XX-01	PRIMARY PUMP START/STOP	DO
17	C-XX-02	PRIMARY PUMP STATUS	DI
18			
19	C-XX-03	ZONE PUMP START/STOP	DO
20	C-XX-04	ZONE PUMP STATUS	DI
21			
22	C-XX-05	ZONE PUMP START/STOP	DO
23	C-XX-06	ZONE PUMP STATUS	DI
24			
25	C-XX-07	BOILER INTERLOCK	DO
26			
27			
28			
29			
30			

Figure 4-8j. DDC control system I/O table and data terminal strip layout for single building hydronic heating system with hot water boiler.